Economic Council
of Canada

Conseil économique
du Canada

Working Paper
Document de travail

Working Paper No. 9

Thinking Intergenerationally

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Nov. 9, 1990

ISSN 1180-3487

92-05328/

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The findings of this paper are the personal responsibility of the author and, as such, have not been endorsed by the Members of the Economic Council of Canada.

Contents

Acknowledgments vii

Foreword ix

Introduction 1

Ethical Considerations 2

Accounting Issues 5
- A Measure of Economic Welfare 5
- Social Indicators 7
- The Measurement of Assets 9

Intergenerational Impacts 12
- Savings and Investment 13
- Technical Know-How 20
- Human Capital 21
- Natural and Environmental Resources 23
- Demographic Changes and the Prospects for Today's Young 29

The Role for Government 31
- General Considerations 31
- Uncertainty and the Limits of Intervention 33
- The Scope for Policy Reform 34
- Reform of the Political Process 36

Conclusions 37

Notes 41

Bibliography 47

Figures

1 Environmental Degradation and Resource Depletion 11
2 Selected Indicators of Environmental Concerns 27

Acknowledgments

This paper benefited from comments and suggestions by Robert Jenness, Harvey Lazar, and Lars Osberg.

Foreword

In recent years we are hearing increasingly about the potential impact of our activities on future generations of Canadians. There are a number of sources of concern. There is growing recognition of the potentially dire consequences of activities that degrade the environment. Concern has also focused on the large and burdensome public debt future generations will inherit. Demographic developments give further cause for reflection; the proportion of elderly in the population will approximately double over the next 50 years and the growth in the proportion of elderly "dependents" could add to the burdens facing Canada's future working population. In addition, recent trends suggest that we should not count on productivity growth to ensure continuing significant gains in earnings for future workers.

In this study, the author develops a framework within which to consider these various developments and he examines the diverse economic literature that is relevant to our attempt to unravel the linkages between generations. Many of the developments of concern impinge in some way on the net wealth we will bequeath to future generations. There is a large body of research analysing savings behaviour, human capital development, and changes in resource and environmental capital, but, as the author shows, there are major gaps in our understanding of the process of wealth accumulation.

Any attempt to come to an overall assessment of intergenerational transfers requires that we address some serious measurement problems and make some difficult ethical judgments. The study examines efforts to come to terms with these issues. As a result of these problems and uncertainties regarding the future pace of productivity growth, it is exceedingly difficult to design policies to improve intergenerational equity. But, even if we cannot draw any conclusions about the adequacy of the sacrifices by the current generation, we can identify opportunities to improve wealth creation in the context of the existing preferences of Canadians for current consumption.

Ron Hirshhorn is a senior economist on the staff of the Economic Council. This study was undertaken as an exploratory survey of a topic that was of interest to Council management and seen to require clarification and elaboration. Some of the results of this paper served as background for the Council's Twenty-Sixth Annual Review.

Judith Maxwell
Chairman

Introduction

> Intergenerational transfers between working-age cohorts and the elderly assume a bewildering variety of forms.... It is not clear how one might begin to estimate even the direction of net intergenerational transfers [John Burbidge, 1987, p. 2].

This paper was prepared as an exploratory study into a possible new area of research for the Economic Council. The implications of current activities for the welfare of future generations has become an issue of widespread and increasing concern. In terms of the required analysis, what immediately strikes one about the subject of intergenerational equity is its scope and complexity. The definition of "equity" is obviously problematic. But even if our interest is in tracking (rather than evaluating) intergenerational effects, the exercise is confounded by the fact that virtually all current decisions have some implications for future welfare. This paper does not attempt to resolve the resulting difficulties. The purpose of this overview is simply to provide a background for further work by identifying the diverse strands of economic analysis that have important bearing on the issue of intergenerational equity.

A major channel through which one generation impacts on another is through its bequest of wealth or capital, broadly defined. Much of the literature discussed in this paper pertains in some way to capital. But the focus is from different perspectives: some researchers are interested in measuring the capital bequest; some, in understanding how current activities affect that bequest; and some, in deriving the normative implications for government policy. Within each of these general subject areas there are, in turn, a number of challenging issues to be addressed.

This paper elaborates on these different aspects. It is organized around a number of broad questions. First, what *should* be the division of economic well-being between this and future generations? The attempt by economists to incorporate various ethical assumptions within models of intergenerational resource allocation is examined in the first section. Second, how do we calculate *actual* changes over time in economic well-being? Such measurement issues are examined in section 2. Third, what are the processes by which this generation affects the well-being of future generations? Section 3 examines various efforts to identify and understand the relevant relationships. And, fourth, what is the appropriate role for government? In section 4, we look, in a general way, at the implications of intertemporal inefficiencies and inequities for government policy. Section 5, the conclusion, reviews some of the main themes of the discussion.

Ethical Considerations

What are appropriate ethical criteria by which to judge trade-offs between the well-being of present and future generations? The answer to this question will obviously be critical to how we interpret our obligations to our descendants. Economists have not had much to contribute to the philosophical issues which underlie the choice of equity criteria. But, through growth models, economists have helped us understand the implications of alternative equity criteria in terms of the consumption/saving choices available to society.

One of the earliest and best known models is that of Frank Ramsey [1928]. With some simplifying assumptions that limit the difference between present and future periods (i.e., given tastes, given factors of production – including a constant labour force – given techniques), Ramsey attempts to work out the consumption path over time that maximizes utility. It is assumed, as is usual, that both the returns to capital and the utility of consumption increase at a diminishing rate. But Ramsey does not discount the utility of future generations, which he regards as unethical. Under these conditions utility is maximized where investment proceeds according to the requirement that the percentage rate of decline of marginal utility be equal always to the percentage rate of return on capital. In other words, the current generation should save as long as the gains from investment exceed the losses from foregone consumption. Based on the postulates in the model, the optimal consumption path grows at a diminishing rate until it finally levels off at the highest possible level.

Dasgupta and Heal [1974] have developed a more elaborate model which incorporates some important extensions. The D-H model is flexible in the sense that it allows for alternative behavioral and ethical assumptions; the optimal consumption path ultimately depends on the values that are chosen for the rate of discount and the elasticity of marginal utility with respect to consumption. In addition, the concept of production is extended to include (along with capital and labour) the contribution from a depletable stock of natural resources. With exhaustible resources, investment is necessary so that reproducible capital (i.e., factories and machines) will be available to offset the declining resource stocks.

As in Ramsey's model, the objective is to maximize the utility of consumption over time. The population and labour force are again held constant. The optimal consumption path depends, to an important degree, on the ease with which reproducible inputs can be substituted for exhaustible resources (i.e., the elasticity of factor substitution), along with the response of output to the change from resource to capital inputs. The pace of substitution away from scarce resources will be influenced by available technology, which can itself change over time in response to changes in relative factor prices.[1] The

optimal generational time path is also dependent on the discount rate. With a positive discount rate – one dollar of consumption in the future being worth less than a dollar of consumption today – the optimal consumption path declines, tending to zero over the long run. On the other hand, with a zero discount rate the optimal path is characterized by continuous growth both in the stock of capital and in consumption.

Solow [1974] employs a production function similar to D-H to examine the consequences, in intergenerational terms, of Rawls' theory of justice. Rawls [1971] argues that if all individuals in a society were to get together in an "original position" where no one knows how they will fare in terms of alternative forms of income distribution, they will find it rational to agree on a rule of maximizing the welfare of the least well-off member of the society.[2] This "max-min" principle involves a departure from traditional welfare functions in which the utility from consumption is aggregated over time and appropriately discounted. Under Rawls' criterion welfare is maximized when the average consumption of all generations are equal; so long as one generation is less well-off, welfare can be improved by transferring consumption from other generations to this one. While satisfaction of the required equality conditions would seem to preclude saving and investment (since in reducing its consumption, a generation would lower total welfare under the proposed criterion),[3] this is not the case, as Solow shows, when we allow for technological progress. Consumption can now be increased in earlier periods through negative net savings (i.e., decumulating capital) and be maintained at this higher level in subsequent periods through the effects of advancing technology.

The implications of the "max-min" principle for the treatment of exhaustible resources is examined by Solow and by Hartwick [1977]. Both consider the investment rule that is required to prevent the current generation from living off the use of exhaustible resources and shortchanging future generations. Hartwick (unlike Solow) allows for the cost of extracting resources, and he makes two important assumptions: that the elasticity of substitution between exhaustible resources and other resources is unity, and that the elasticity of output with respect to reproducible capital exceeds the elasticity of output with respect to natural resources. Under these conditions and with a given-sized population, per capita consumption can be maintained constant over time by the efficient extraction of resources[4] and the continual investment of all resource rents in reproducible capital. Under this arrangement, exhaustible resources are essentially converted into machines and assuming (as the model does) that machines do not depreciate, the total stock of productive capital is maintained over time. The prescribed investment rule will not sustain per capita consumption if there is depreciation.

Mishan [1977] has looked generally at intergenerational modelling by economists, and he argues that "the models are 'cooked up' so as to give the

imprimatur of science to what is, after all, no more than a popular ethical judgment." His point is that these models are based on assumptions about the ability of market decisions to reflect individual utility along with ethical judgments about the appropriate distribution of income, and on both issues economists have nothing of substance to contribute. For example, the constant consumption per capita prescription in Solow's model is based on an ethical criterion which is imported from outside economics. The successive extensions Solow introduces (i.e., increasing population, depletable resources, unlimited technical progress) "act only to alter the magnitude of the constant consumption path and to modify the necessary conditions for its attainment" [Mishan, 1977, p. 394].

Despite his scepticism about modelling, Mishan in fact supports the egalitarian criteria adopted in most intergenerational models. His reasoning here is interesting. Within a given society, the argument for equal sharing derives its appeal from the judgment that a person's material success is largely the result of factors outside his control. Egalitarianism is not perceived as just to those who regard the individual as being mainly responsible for his own fate. But whatever the attraction of the latter position in an intragenerational context, it cannot be used to dismiss the obligations of one generation to another. Given the reasonable supposition that the distribution of relevant personal characteristics is much the same from one generation to another, "we can agree on each generation's right to a natural resource and capital endowment that, with the same average effort, will produce for it the same per capita real consumption as that of any other generation" [Mishan, 1977, p. 397].

Even if there is agreement, however, that egalitarianism is generally appropriate on ethical grounds, it is not entirely clear what the operational criteria should be. If, for example, we are comparing various distributions between generation 1 and generation 2, it is clear that alternative a is inferior to an alternative such as b, which represents increased per capita consumption for both generations. But how does b compare if instead it represents the same level of consumption for generation 1 and increased consumption for generation 2? Or what if b involved some slight fall in the consumption of generation 1, but a very substantial increase in well-being for generation 2?

Further, one might question the appropriateness of egalitarianism for a dynamic economy. With technological progress it is possible to sustain a given level of consumption per capita with a steady decline in the capital-output ratio. The current generation could conceivably consume capital and still fulfil its obligations under the constant per capita consumption criterion. Nordhaus and Tobin [1972] suggest that a more reasonable requirement is for each generation to invest an amount required to maintain a constant ratio of capital to output. In this case consumption per capita will grow over time in pace with the rate of technological progress.

Once there is agreement on the appropriate distributional criteria, there is then the problem of how these are to be applied. Here we come up against a number of difficulties, not the least of which is the identification and measurement of the relevant variables. At the current time, for example, most observers expect that productivity growth will lead to higher per capita incomes for future generations of Canadians. An egalitarian approach might therefore be seen to justify increased consumption and reduced investment by the current generation. But this could be highly inequitable if the activities of the current generation are reducing the opportunities of future generations in ways that are not captured by the available economic measures. We examine these accounting-related problems in the next section.

Accounting Issues

To meaningfully assess the position of one generation relative to another we require some overall indicator of well-being or social welfare. It has long been recognized, however, that the most widely used index of growth, GNP, is inadequate even from the limited standpoint of measuring material improvement. Whereas the objective of economic activity is consumption, GNP is an index of production. Errors and biases – such as the failure to value household work and to fully account for environmental pollution – are not too serious a problem when GNP is being used to gauge the performance of the economy on a year-to-year basis. But as a measure of how we're doing compared to generations of, say, 50 or 100 years ago, GNP will be a very misleading indicator.[5]

The response to these problems has taken different forms. One line of inquiry has focused on the possibility of adjusting the Income and Product Accounts so that they more nearly reflect changes in economic welfare. Another response has taken the form of efforts to supplement the available economic data with "social indicators" that depict some of the more important qualitative aspects of economic and social change. Alternatively, we may refrain from attempting to assess welfare directly and focus instead on the stock assets being passed on to support the consumption of succeeding generations. A reasonably complete record of assets will allow for an assessment of the sacrifices in consumption that have been made by past generations and that are being made by the present generation on behalf of future generations. In what follows we elaborate on each of these approaches.

A Measure of Economic Welfare

The best known study in this area is the pioneering attempt by Nordhaus and Tobin [1972] to adjust GNP so that it is closer to a "measure of economic welfare" (MEW). The calculation of MEW involves the addition to

GNP of the benefits from certain non-market activities, and the subtraction from GNP of certain costs which are intended primarily to overcome the negative effects of economic and social change.

Nordhaus and Tobin attempt to impute a value for the expansion of leisure time which has occurred over the years. They also attempt to measure the production of household services, thereby removing the substantial upward bias that exists when the entry of women into the labour force is added to GNP, but there is no corresponding subtraction for the services they would otherwise have provided in the home.

Among those items to be subtracted from GNP are a number of "regrettable expenditures." These are expenditures designed to overcome the negative effects of industrialization and changes in the social and political environment; their effect is not to increase, but simply to sustain economic welfare. Included in this category are local expenditures for police, fire, and sanitation as well as national expenditures for defence and diplomacy. In fact, however, it is far from clear that the "stock," say, of national security or of local safety has been maintained over time.

Nordhaus and Tobin also try to take account of the negative costs of urbanization, which are not reflected in the national accounts. Through cross-sectional regressions they estimate the income differentials necessary to hold people in localities with greater population densities. While the resulting "disamenity premium" is substantial, taking account of the overall effects of urbanization doesn't significantly reduce the estimate of economic growth.

Another set of deductions arises from the attempt to more precisely separate intermediate from final outputs. The contributions of intermediate outputs are completely counted in the value of other goods and services, and should therefore not be included separately in calculating consumption. The output required to offset the depreciation of the capital stock is an important intermediate product. The deduction for depreciation increases in the MEW calculation because Nordhaus and Tobin expand their concept of capital to include wider forms of government investment, and public and private investment in education and health. The depreciation of environmental capital is not taken into account, although it is suggested that it may not significantly influence the estimation of total wealth.

Following Bartelmus [1987*a*], the calculations involved in the construction of MEW can be summarized as follows:

$$MEW = GNP - CC_{pc} - R^g - R^h + L + S^h - D + S_c - CC_b - CC_g$$

where CC_{pc} = traditional consumption of produced capital;

R = "regrettable" expenditures of government (R^g) and households (R^h);
L = imputation for leisure;
S^h = imputation for household work;
S_c = imputation for private and public capital services;
D = disamenities of urbanization;
CC_b = additional capital consumption due to the broader concept of capital formation; and
CC_g = the increase in the capital stock required to maintain the capital-output ratio in a growing economy.[6]

The preliminary calculations by Nordhaus and Tobin suggest that the most important adjustments are the imputations for leisure time and for household work. MEW per capita was found to be growing, although more slowly than GNP or NNP per capita (1.1 per cent for MEW vs. 1.7 per cent for NNP over the 1929-65 period).

The calculation of MEW involves a number of conceptual and measurement problems. The valuation of leisure, for example, will vary greatly depending on the price index that's chosen for the purpose of deflating the opportunity cost of leisure time. The identification of those outputs that are final and welfare-enhancing involves a high degree of judgment. The estimation of "regrettable" expenditures and environmental disamenities is subject to a high degree of imprecision. For these and other reasons, national statistical agencies have not embraced the MEW concept. After reviewing a report on the feasibility of welfare-oriented measures, the Statistical Commission of the United Nations concluded "that it would be inappropriate to attempt to develop international standards for an aggregate designed to measure welfare" [1977, p. iii].

Social Indicators

As an alternative to constructing a single monetary measure of economic welfare, some researchers have attempted to develop a set of social and demographic statistics that could supplement economic measures by depicting some important qualitative aspects of growth. The data on employment and earnings tell only part of the story. What is seen to need consideration are some neglected aspects of change, including the distributive effects of economic growth, the results of non-market activities, and environmental impacts.

The general approach of the social indicators research is to determine major areas of social concern and sub-concern and to construct measures that meaningfully summarize changes in these areas over time. This was the focus of efforts at Statistics Canada, that resulted in the *Perspectives Canada* series

of publications. The Economic Council's research into social indicators in the early 1970s was somewhat more ambitious, the aim being to construct models which could explain changes over time among some key indicators of well-being.[7]

A review by the United Nations [1978] suggests there is reasonable consensus on what are the major societal concerns. In most countries the indicators that have been assembled relate to: education, employment, consumption, distribution of income and wealth, social security, health, housing conditions, time and leisure, and social stratification. There is much less agreement, however, on what are the operational sub-concerns and on what data are representative of these sub-concerns.

Even the development of an appropriate set of economic indicators can be a matter of dispute. This is perhaps best illustrated by the recent concerns that have been expressed about the disappearance of the North American middle class. Kosters and Ross [1988] have examined the U.S. evidence and they find this concern to be unfounded. But the Kosters and Ross study shows how sensitive results are to the particular measure of earnings selected, to the price index used to adjust for inflation and to the year chosen as a reference point. The trend over time in various measures of economic well-being has also been the focus of some recent articles in the more popular press, such as the stories in *Fortune* [Nasar, 1987] and in the *Report on Business Magazine* [Maynard, 1988].

Interest in social indicators has waned in recent years, with the recognition that indicators intended to depict welfare will inevitably be subjective and highly controversial. Bartelmus [1987*a*] quotes the results of one study which compared various social indicators with individuals' subjective assessment of the quality of life and found that "none of the existing indicator systems – neither the economic, the social, nor the QOL (quality of life) indicator system – is able, in itself, to give an adequate picture of people's life quality" [Hankiss, 1983, p. 25]. More recently, efforts have shifted from the development of social indicators to the specification of accounting relationships in areas outside the traditional national accounts framework. The United Nations, for example, has attempted to develop a System of Social and Demographic Statistics (SSDS) that would present stocks and flows of individuals, their activities, and life sequences in an accounting structure. The French Satellite Accounts present data on social fields such as education, health, and environmental management so as to highlight the interrelationship between those who are involved in production, those who are financing it, and those who are beneficiaries of it.[8] Both efforts involve an emphasis on the more comprehensive and systematic development of social statistics, and a de-emphasis on assessing the data and attempting to fit them within a welfare framework.

The Measurement of Assets

The measurement of assets provides a direct way of looking at how the activities of one generation impact on the economic opportunities of another. Potential consumption per capita will rise if the total capital bequeathed to each child exceeds the capital inherited by each parent. If, on the other hand, the wealth of the economy is run down so that it will be unable to sustain the same level of per capita consumption in future years, the behaviour of the current generation might be questioned on ethical terms (following Mishan's suggestion, as discussed previously).

The distinguishing characteristic of capital is its ability to generate services and contribute to income over a succession of accounting periods. The contribution of capital may be in the form of productive services, as in the case of machinery, or in the form of consumable services, as in the case of housing or the recreational services provided by the forests. The consumable services provided by capital must be taken into account in determining the value of the capital stock, although these services are provided directly without market transactions.[9]

From an intergenerational perspective, it is the total *net* stock of wealth that is of interest. This requires appropriate adjustments for additions to the capital stock as well as for deletions resulting from the depreciation of reproducible capital and the depletion of resources. Procedures for evaluating the stock of wealth must attempt to capture changes in the quality as well as in the quantity of capital – more productive machinery, for example, or, on the negative side, the degradation of the environment from air, soil, and water pollution. More debatable is the appropriateness of an adjustment to reflect capital gains and losses.[10]

To discuss the measurement of capital we must set aside some profound theoretical difficulties that have been raised by Joan Robinson and her Cambridge colleagues.[11] After doing so, however, we still come up against some serious estimation problems.

In the Canadian System of National Accounts (SNA), the scope of capital measurement is currently confined to reproducible assets (i.e., machinery and structures, consumer durables, and inventories) and land for which a market price exists (i.e., excluding Crown lands). This clearly provides a very limited and inaccurate picture of the resources society has devoted out of past production to provide for present and future output. By contrast, John Kendrick [1976] has shown how a broad view of investment would include measures of tangible as well as intangible human and non-human capital. In Kendrick's study, the concept of the capital stock is extended beyond its traditional components (machinery and structures) to include: consumer durables, land

and other natural resources, the pool of productive knowledge resulting from R&D, and human capital broadly defined. The components of human capital include rearing costs, education and training, health and safety investment, and the costs of job search and worker migration.

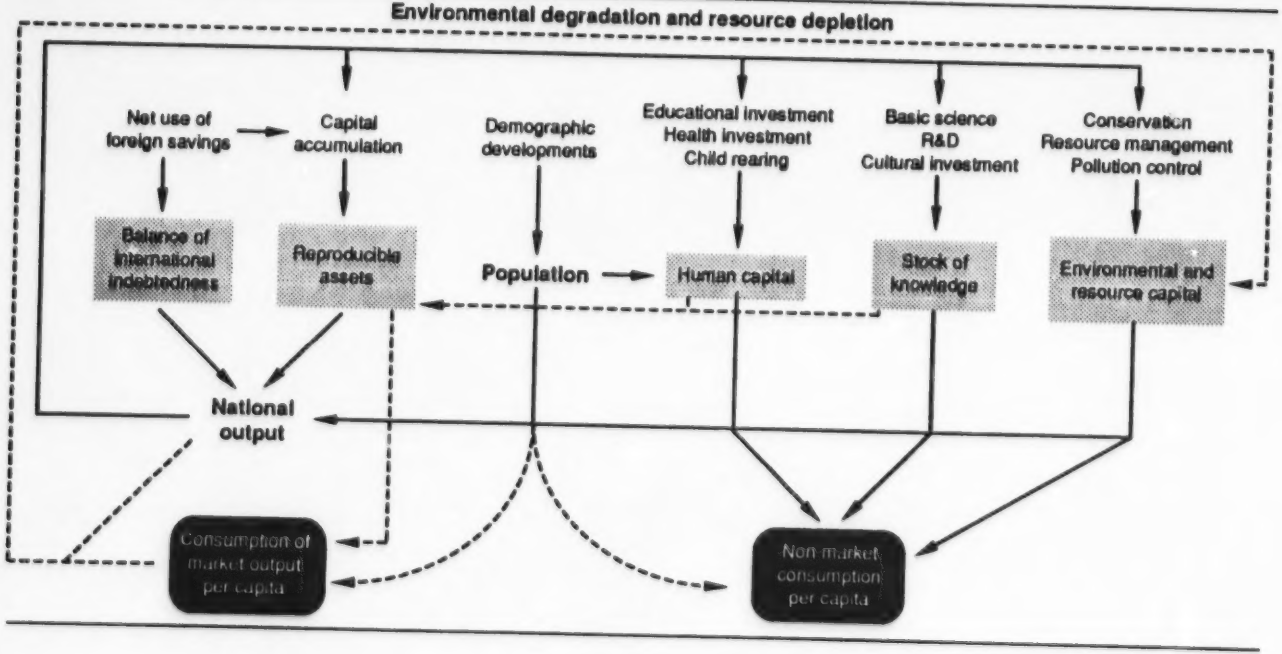
More recently, Juster, Courant, and Dow [1981] have focused on the capital stock in the context of a broad social accounting framework in which the outputs that contribute ultimately to well-being derive from the allocation of time to market and non-market activities. In this framework the capital stock encompasses a broad range of "states of being" which condition the outcomes from the use of time in particular activities. Thus the proposed capital account includes: tangible assets, such as machinery and houses; human capital, such as health, skills, and knowledge about the history and properties of the world not embodied in specific individuals; organizational capital reflecting networks of relationships among the particular people populating society; social-political capital reflecting the institutional arrangements for collective activities and rules and conventions governing social interaction; and environmental capital reflecting the physical and biological surroundings of human society.

Conceptually, the main components of the capital stock can be portrayed so as to highlight their interrelationship with various economic and non-economic activities. Figure 1 depicts the main components of the nation's wealth and the activities that influence wealth accumulation. The figure is not intended to be comprehensive; the stock of knowledge, for example, will depend more on worldwide research than on Canada's own investment in basic science and R&D. However, it illustrates how wealth accumulation depends on the decision to forego consumption and engage in a variety of investment activities. The diagram shows that the nation's wealth includes much more than is in the "national balance sheet" produced by Statistics Canada (which consists primarily of the balance of international indebtedness and the stock of reproducible assets). It also highlights the need to take account of the capital decumulation resulting from environmental degradation and resource depletion – again, something which is omitted from national accounts' calculations. And the figure conveys the message that assets such as environmental and human capital are not simply factors of production; they also contribute directly to individual utility and this needs to be considered in assessing the long-term implications of current activities that affect these assets.

Putting numbers to these components of Canada's wealth is clearly a complex task. Even in the case of productive or reproducible capital, where data has been available for some time, certain aspects of Statistics Canada's estimating procedure are open to question.[12] The difficulties of estimation multiply as we move into the areas of human capital and intangible non-human capital. Kendrick, for example, measures human capital by assessing the

Figure 1

Environmental Degradation and Resource Depletion



cumulative costs of investment in education, health, child-rearing, etc. The implicit assumption that increased expenditures translate into increased productive capacity ignores a range of controversial issues. A more recent study by Jorgenson and Fraumeni [1987], in which human capital is evaluated by calculating the present value of lifetime labour incomes for all individuals in the U.S. population, arrives at much higher estimates than Kendrick. Jorgenson and Fraumeni estimate that human capital comprises over 70 per cent of the total capital stock in the United States. In the case of intangible non-human capital, which is essentially the stock of productive knowledge and know-how, it is unclear how one would go about identifying, let alone evaluating, the relevant components. This latter form of capital, however, may well constitute the most important bequest made by one generation to another.

In the resource area, it's necessary to take account of both the role of resources as inputs into the production process and the function of the environment as a direct source of consumable services. In terms of the former, what is of interest is the value of the nation's resource endowment and changes in the stock of renewable and non-renewable resources as a consequence of both human and natural activities. Measurement of the waste- and pollutant-absorbing function of the environment poses a still more challenging problem. Conceptually, one can think of airsheds and watersheds as capital goods with an implicit price equivalent to the present discounted value of the waste disposal services they provide. But since environmental services are untraded and unpriced, one is forced to search for proxy indicators that will provide some reasonable indication of changes in the value of these assets.[13]

At present, the available data are much better geared to understanding the role of the environment as a factor of production than as a waste disposal system. In a recent report, Friend [1986, p. 46] observed that data collection in Canada "is largely driven by the operational needs of the resource departments and their client industries," and so "we find relatively well-organized databases in the areas of mining, forestry, agriculture and fisheries, and a paucity of data on non-economic variables, i.e., fauna and flora, and ecosystems." But this is changing. The current interest in the environment is generating pressures to overcome these gaps in our statistical reporting system.

Intergenerational Impacts

Our focus in this section is on the linkages between the activities of the current generation and the welfare of future generations. This involves, first, an understanding of how economic decisions made today will impact on the opportunities for consumption in future years. Secondly, we may be interested in looking, more particularly, at the future prospects for a specific population cohort: How, for example, will the economic decisions that are being made

today in conjunction with the demographic changes that are in progress impact on the opportunities of the young, or those who will constitute the working age population in, say, 25 years?

From the previous discussion, we can see that current activities will influence future economic welfare by way of their impact on the quantity and quality of assets available to support consumption in future years. An examination of the first question, therefore, entails an exploration of the linkages of the type depicted in Figure 1 between activities (or flows) and assets (or stocks). The creation and dissipation of wealth is a large and complex topic, and our intention below is merely to highlight some of the more important aspects of this issue. Particular attention is given to savings and investment both because this is a focus of a considerable body of economic literature and the adequacy of current savings has been the subject of some of the most widely cited intergenerational articles.[14] Following the discussion of how current activities influence some of the main components of the nation's wealth, we will look briefly at the second question, involving an assessment of the prospects for a specific population cohort.

Savings and Investment

Family Savings

Savings and investment decisions can be analysed from the point of view of the individual or family and at the aggregate or macro level. Within families, parents determine their own consumption and the capital they will transfer to their children through investments in child-rearing and education, and through bequests. The willingness of parents to forego consumption, combined with population growth (and the increase in the number of children per family), determine the extent to which children benefit from intergenerational transfers.

A major purpose of savings is to compensate for the unevenness of earnings and needs over time. Individuals save "to build up a reserve against unforeseen contingencies" (i.e., satisfy a precautionary motive) and to "provide for an anticipated future relation between the income and the needs of the individual or his family different from that which exists in the present as, for example, in relation to old age, family education, and the maintenance of dependants" [Keynes, 1936, p. 107].

Accordingly, one might expect that rational consumers would adjust savings over time so as to maintain the relationship between consumption and their expected lifetime wealth. In this vein, the life-cycle theory predicts that the pattern of savings over the individual's life cycle will have a "humped" profile – the substantial savings that occurs in the middle years contrasting with

the dissaving that characterizes the early and later periods of a person's life. But the evidence – as examined, for example, by Courant, Gramlich, and Laitner [1986] – indicates that consumption depends strongly on current income, as distinct from lifetime or permanent income. The young and old do not consume to the degree suggested by the life-cycle hypothesis. Among the reasons for this is the existence of liquidity constraints; the young often cannot borrow against their future earnings to achieve the higher consumption they desire. Also, and again contrary to the life-cycle hypothesis, people seem to be influenced by the composition as well as the size of their wealth holdings. The elderly tend to have a high proportion of their wealth in the form of housing equity, but, as Venti and Wise [1989] show, they are reluctant to draw on this asset to finance increased consumption.

In addition to providing for one's varying needs over the life cycle, individuals save so they can transfer wealth to their children. A major point of dispute concerns the nature and implications of the bequest motive. In a much-cited article, Barro [1974] developed a model of altruistic parents, whose utility is dependent not just on their consumption, but also the utility of their children. This model has important implications for the response of individuals to any attempt by the government to impose a burden on future generations. For example, a tax cut that is matched by a rise in the debt to be serviced by taxes on future generations would involve a redistribution that is contrary to the wishes of parents. The latter would respond by increasing their bequests to offset the effect on their children of future taxes.

In the extreme form of this hypothesis, savings increase to fully offset increased government borrowing and interest rates, asset prices, and consumption and investment are all unchanged. Under these circumstances the distinction between taxation and debt finance is largely irrelevant. Implicit in this hypothesis is the assumption that taxpayers correctly anticipate the future tax implications of fiscal decisions and that this enters into their evaluation of their own and their offspring's perceived wealth. It is also assumed that consumption demand depends on perceived wealth – that is, individuals' evaluation of the present value of their future disposable income. Grossman [1982] has criticized the second assumption because it neglects "liquidity effects" on consumption demand. There are many households that consume less than they would prefer because of their limited ability to borrow against prospective future income. Reductions in current taxes, even if they do not alter perceived wealth, would allow these households to satisfy their preference for more current consumption.

Other aspects of the controversy pertain to the size and importance of bequests, and the extent to which bequests are responsive to government-imposed transfers. With respect to the first issue, most studies suggest that, in the U.S., bequests account for a significant but minor portion of wealth –

less than 25 per cent. An exception is a recent study by Kotlikoff and Summers [1981] which finds that inherited wealth may comprise up to 80 per cent of total measured wealth based on a somewhat broader definition of bequests – one that Modigliani [1988] questions. As for Canada, studies by Davies [1982] and Davies and St-Hilaire [1987] suggest that the ratio is between these two extremes – somewhat over 40 per cent.

In terms of theory, Barro's interpretation has been challenged by alternative models in which bequests are not responsive to government-imposed transfers. Bernheim, Shleifer, and Summers [1984] depict bequests as a strategic device for maintaining the attention, and possibly the affection, of children and grandchildren. Kotlikoff and Spivak [1981] see bequests in the context of an implicit or explicit contract in which parents agree to leave a bequest if they die before a certain age whereas the children agree to support their parents if they live beyond that age and exhaust their assets. Alternatively, parents may regard themselves as "stewards" of the family's wealth with a moral responsibility to pass on to their children at least what they themselves inherited. In a recent article, Feldstein [1988] finds that even if altruism is the operative motive for bequests, so long as individuals are uncertain about their future income they will not respond to deficit financing in the way Barro suggests. A "young" individual who is uncertain about his future income and uncertain as to whether he will ultimately make a bequest will be inclined to increase his consumption in response to a tax cut financed by an increase in the national debt.

In most models, the number of children who will share in their parents bequest are taken as given. But Becker [1988] has suggested that the number of children demanded may be positively related to the income of parents. In this Malthusian world, the birth rate becomes an equilibrating factor, and over the long-term there is stability in the capital-labour ratio and per capita income.

Aggregate Savings and Investment

Most popular discussions of intergenerational issues proceed from an examination of aggregate savings and investment, although, in fact, the issues of concern at the aggregate level can often be traced to aspects of the utility-maximizing behaviour of individuals.

Discussions of aggregate savings behaviour are subject to the sorts of measurement problems discussed in section 2. So, for example, in estimating personal savings, the national accounts does not adjust for the fact that durable goods are not entirely consumed in the year of purchase; that portion of the benefits that will be available in future years should properly enter into the calculation of savings. In a recent paper [1989], Dagenais attempts to correct for this and other problems by calculating personal savings in terms of the

change in the net wealth of the personal sector. However, this approach also raises a number of questions: Should personal savings incorporate capital gains and losses? How should the net change in accumulated human capital – presumably, an important component of personal wealth – be calculated? And should the value of future social security benefits be included in the measure of net wealth? The last question takes us back to the controversy as to whether or not individuals are cognizant of the taxes which will be levied to cover future social security payments. If so, inclusion of this tax liability would offset the social security asset.

One important change at the aggregate level is that the behaviour of families and the savings of individuals are not constraints on investment. In an open economy, any gap between desired investment and domestic savings will be filled by foreign savings.[15] Moreover, real interest rate movements in a small open economy such as Canada tend to closely follow changes in real interest rates in the rest of the world.[16] Therefore, there is less reason to fear that inadequate domestic savings will reduce the growth of the capital stock; rather, the concern relates to the continuing burden of debt service payments to foreign lenders and to the adjustment problems arising from the upward pressure capital inflows exert on the exchange rate.[17]

In the United States, there is presently concern that the country's sharply rising dependence on foreign savings will imperil the economic well-being of future generations. Peterson [1987] contends that foreign borrowing has gone to support consumption (rather than investment) and at the root of this excessive consumption is the high level of deficit spending by the U.S. government. Future generations will, it is claimed, have to pay the bills for this high living by the current generation. Consumption will ultimately have to be curtailed both to pay the rising debt service costs to foreigners and to provide the basis for a continuing reduction in the country's merchandise trade deficit.

In considering the relevance of these concerns to Canada, it is necessary to take account of the much higher personal savings rate in Canada than in the United States – based, that is, on admittedly incomplete national accounts data. Whereas rates of personal saving trended down in the United States through the 1970s, they rose dramatically in Canada. In both countries, the government sector has become a significant dissaver, or net borrower, but in Canada the offsetting rise in personal savings helped to maintain overall domestic savings remarkably stable through the 1970s. In the 1980s, however, there has been a significant decline in personal savings rates in Canada. Accordingly, as recovery from the 1982-83 recession progressed, the borrowing requirements of the public and corporate sectors have been met by an increased reliance on foreign sources of savings.

Adjusting savings rates for the effects of inflation – as, for example, do Jump and Wilson [1986] and Italiano [1988] – leads to some moderation in

trends, but the pattern between the mid-1970s and early 1980s is still characterized by rising personal savings rates and increasing government dissaving. More recently, inflation-adjusted government budget balances have improved, while real personal savings rates have declined. The high savings rate of the personal sector in the 1970s and early 1980s helped to finance the accumulation of assets and to reduce Canada's reliance on foreign sources of savings. Business investment in Canada has weakened recently, but it is interesting that growth rates in Canada's stock of productive capital, in fact, increased over the latter half of the 1970s notwithstanding the general slump in Canada's productivity performance.

Whether domestic savings in Canada are adequate is a judgment which depends on a number of considerations. It depends, first, on the criterion of intergenerational equity being adopted, which may suggest a requirement for either constant or rising per capita consumption. It depends on the contribution to future productivity growth which the current generation has made through investments in human capital and technical know-how. It depends on the degree of capital-widening that is necessary, given the growth of the population and the labour force. And it depends on the extent to which the growth in reproducible capital simply offsets the decline in resource and environmental wealth. Considerable analysis is obviously required before one could reach a conclusion on any of these issues. What we can say is that to the extent the savings rates of domestic agents are a source of concern, this applies to the actions of the government sector and, to a lesser extent, to the recent change in personal savings behaviour. The possible relevance of the issues raised by Peterson arises mainly from the significant growth in the federal deficit since the mid-1970s.

The Burden of Public Debt

The burden that the public debt imposes on future generations has been a subject of much attention in the literature. It has long been recognized that a public debt which is financed domestically does not create a net liability and is, in this sense, different from personal debt to which it is often misleadingly compared. Lerner [1948] makes the point as follows:

> [Private debt] is owed by one person to others. That is what makes it burdensome. Because it is interpersonal the proper analogy is not to national debt but to international debt. A nation owing money to other nations . . . is impoverished or burdened in the same kind of way as a man who owes money to other men. But this does not hold for national debt which is owed by the nation to citizens of the same nation. There is then no external creditor. "We owe it to ourselves."

In a closed economy the debt associated with government spending is not a burden, although, as Lerner points out, if the resulting interest charges are

large, the taxes required to finance these payments might create some burdensome disincentives and dead-weight losses. However, future generations may be disadvantaged if public spending crowds out private investment and reduces the rate of wealth creation. This can only occur under conditions of full employment where there is no excess (desired) savings in the economy. Moreover, for there to be crowding-out, there must be an increase in real public debt; an inflation-induced increase in public borrowing will not result in additional pressure on capital markets. Models suggesting a future burden also assume that government spending will not itself lead to the creation of assets, or at least assets which are equally productive to those that would have been created through private investment.[18]

In an open economy, government debt will impose a net burden on future generations to the extent it gives rise to foreign debt which is not matched by a parallel growth in the country's productive assets.[19] The increase in Canada's foreign liabilities will arise whether the government itself issues its debt abroad, or whether the government borrows domestically and causes other Canadians to resort to foreign borrowing. Government borrowing will not be a burden if it leads to an offsetting rise in private savings. This could occur at times of unemployment when the stimulus provided by deficit spending can provide an important boost to both national income and domestic savings. Alternatively, it may be that altruistic individuals who are benefiting from the government spending will increase their savings to offset the future taxes required to service the increase in the national debt. This is what's predicted by the so-called Ricardian equivalence theorem that has been popularized by the work of Barro [1974] cited earlier.

Therefore, to understand the impact of the growing public debt on future generations it is necessary, first, to determine whether and to what extent there is a link between this debt and the rising rate of personal savings experienced in Canada.[20] Second, it is necessary to analyse the associated public spending and determine to what extent this involves the creation of assets that will contribute significantly to the well-being of future generations.

Pensions and Savings

The country's mounting pension obligations raise concerns analogous to those pertaining to the public debt. There has been a long debate in the literature about the appropriate financing arrangements for a pension plan. The main alternatives are a "pay-as-you-go" plan in which annual contributions are set so as to generate the revenues for that year's benefits, and a fully funded plan in which each cohort makes enough contributions over its lifetime to cover the costs of the benefits paid out. In Canada, as in most other countries, the pay-as-you-go approach has been preferred, although both the Canada

and Quebec pension plans are partially funded unlike a true pay-as-you-go scheme.

Some economists believe that the pay-as-you-go approach can lead to a significant decline in personal savings rates. With the introduction of such a scheme, those who are then retired will receive a "gift" of pension payments. The costs of these pensions will be covered by the contributions of the working population. If the retired simply increase their spending by the amount of their windfall gain, and workers reduce their private savings by the amount of their contribution (viewing the public plan and its promise of future benefits as a substitute for previously necessary private savings), then overall consumption spending will rise and personal savings will decline. As a result of the reduction in domestic savings, Canada will become more dependent on foreign savings and future generations will be forced to bear the costs of servicing Canada's increased foreign debt.

On the other hand, it is possible that individuals will be guided by altruistic motives, of the sort discussed by Barro [1974] and referred to previously. If the retired who receive a pension "gift" are concerned about the well-being of their heirs, they will be inclined to save their pension receipts and pass the proceeds along to their heirs. Workers may still reduce their savings to match their pension contributions, but they will pass on the bequests they receive from the elderly to their own heirs. The Ricardian equivalence theorem is thus satisfied since current savings are being adjusted to offset the higher contributions faced by future generations. In this case, the pay-as-you-go scheme has no effect on domestic savings rates.

There have been numerous attempts to empirically test these propositions. Atkinson [1987] summarizes much of this literature. Most studies focus on the U.S. Social Security System, a pay-as-you-go plan introduced in the mid-1930s. Feldstein [1974] sparked much of the recent debate with his claim that "the social security program approximately halves the personal savings rate [which] implies that it substantially reduces the stock of capital and the level of national income" [p. 922]. Feldstein's estimates have been challenged by Barro [1978], Leimer and Lesnoy [1982], and Beach, Boadway, and Gibbons [1984] among others. The issue remains unresolved, although more recent studies suggest that if a pay-as-you-go scheme does have a negative effect on savings the impact is probably well below Feldstein's original estimates.

A fully funded plan is less likely to affect savings rates. If workers reduce their private savings by the amount of their contributions (as assumed above), then the effect has been simply to direct private savings into public savings. One concern that has been raised, however, is that there may be influences on the activities of the public fund which may lead to poor investments, judging by either public or private sector standards. If public funds obtain a

suboptimal financial or social return on their investments, then resources will be misallocated and future generations will be worse off as a consequence. Jump [1983] has shown that a funded plan which invests exclusively in government debt may not only contribute to a misallocation of resources, it may also impair savings rate in a manner similar to a pay-as-you-go plan; the need to provide an investment outlet for the fund leads the government to run a higher deficit, which (in the absence of Ricardian equivalence) results in an increase in the overall rate of domestic spending.

Technical Know-How

The examination of savings and investment can help us understand the growth of Canada's stock of productive capital and the extent of Canada's foreign indebtedness. The value of the capital stock we bequeath to future generations, however, depends on its quality as well as its quantity, and this in turn depends on the growth in the stock of technical know-how. Broadly and properly defined technical advance includes not just the introduction of better machinery and equipment, but also improvements in work practices and processes, and the development of new products. Improvements in technical know-how are often difficult to identify and evaluate, and this is especially so when the improvements are not embedded in tangible assets.

The stock of technical know-how is a main determinant of our economic well-being. Denny [1986] contends that "in the long run it is technical progress that drives the improvements in our standard of living" [page 6]. Notwithstanding the importance of technical knowledge, there is much that is unknown about its generation and its precise role.

Studies, such as that edited by Griliches [1984], show that R&D can contribute to technical progress and higher productivity, and the private rate of return on R&D tends to be well in excess of the rate of return on physical capital. Much has been made of the fact that Canada devotes a much lower proportion of its GDP to R&D than most other industrialized countries – the proportion being about half what it is in the U.S. This partly reflects the importance of ideas and technical know-how imported from abroad to a small, open economy. As the Economic Council [1983] has shown, the rate of technical change is much influenced by way in which new technology is adopted from abroad and diffused within Canada. Multinational corporations play an important role in the process, serving as a useful conduit for the import of new ideas and new technology.

However, the diverse circumstances that give rise to technological change and the strategic importance of particular innovations make it difficult to generalize about the factors that contribute to the growth in Canada's stock of technical know-how. Our contribution to future generations, moreover,

consists not just of technical know-how, but also of a body of scientific knowledge which can act as a source for future innovations. It is obviously difficult to assess the advancement of basic knowledge, but pure science may well hold the key to Canada's technological prospects over the indefinite future.

Recently, some have claimed that the rate of innovation in the United States, and by extension in Canada, has slackened. But, as Mansfield [1983] points out, the supporting data "are so crude and incomplete that it would be foolish to put much weight on them." Innovation has declined in some sectors, but accelerated in others. The evidence does not support the view that innovation occurs in long waves and that the North American economy is now in the recessionary phase of a Kondratieff cycle.

While the rate of technological advance may not have slowed down, there are indications that firms are finding it more difficult to absorb the new technologies. It has been hypothesized that the nature of the new technology is such that far-reaching institutional adaptations are required.[21] The failure of firms to introduce the necessary organizational and process changes is seen as one cause of the recent decline in productivity growth. As with other explanations of the productivity slowdown, however, this cannot help us understand the abrupt drop in productivity growth that occurred in the mid-1970s.

Human Capital

The quality of the work force is determined by the age, experience, and health of workers, and by the education and training they have acquired. In an intergenerational context it is the investment in human capital that is of particular interest. The prospects of the future generation depend to an important degree on the current investment of parents in child-rearing, and public and private investments to educate and more generally expand the learning opportunities for children.

To understand the investment of parents in the rearing and education of their children it is useful to refer back again to attempts to model the bequest process. Investment in a child's human capital is an alternative to the bequest of financial assets; both require parents to forego their own consumption. In deciding the amount of the resources they will transfer to their offspring parents will be influenced, for example, by the amount of their actual and expected wealth, by their own material needs, by their concern for the welfare of their children (or their "altruism") and, perhaps, by their expectations for wage growth and improvements in the living standard of future generations.[22] In deciding the composition of the transfer, a major consideration will be the relative return on various forms of investment. As Becker [1988] points out,

child rearing is time intensive, so the return will tend to be lower for parents whose time has a high value. With respect to choice between transferring assets and investing in human capital, the latter will generally be preferred as long as the marginal rate of return on additional human capital exceeds the rate on assets.

If parents do not invest in human capital when it yields a return in excess of that on savings, resources will be misallocated. This situation could arise where the optimal investment in human capital requires a transfer in excess of what parents are prepared to bequeath. In this case, both children and parents would be better off if parents increased their investment in return for a commitment by their children to repay them for the unwanted transfer. But as Becker and Murphy [1988] point out, young children cannot be a party to such contracts. State intervention provides the opportunity to overcome such underinvestment and to raise the provision of human capital to the efficient level.[23]

Public investment in education is the most important, but not the only way by which governments influence human capital development. A significant portion of public spending in the general area of health and social welfare has a significant human investment component.[24] In terms of social welfare, examples would include: welfare payments made to single mothers; the dietary education and advice given to teenage mothers; and the services of publicly supported agencies offering various types of counselling and support to both parents and children. Each of these activities will influence the physical and mental well-being of Canada's future adult population.

Most studies find that public and private investment have contributed over time to an increase in human capital. Jorgenson and Fraumeni [1987] find this to be the case for the United States, although they estimate the growth rate of human wealth per capita in constant prices at only 0.49 per cent per year for the period 1949-84. By contrast the growth rate of non-human wealth per capita in constant prices was found to average 1.65 per cent per year over the postwar period. Since Jorgenson and Fraumeni define human capital in terms of lifetime labour income (and since they incorporate an imputation for the value of non-market activities), their estimates reflect demographic trends and labour force participation in the United States, as well as changes in educational achievement. The effect of changes in education in itself has been more positive. As with all such studies, however, there is the possibility that earnings partly reflect the influence of credentialism and restrictive occupational and professional practices, rather than changes in the productive capacity of labour.

In Canada, the evidence similarly suggests that while demographic changes have tended to lower the quality of the labour force over the 1960s and 1970s,

education has had a significant countervailing influence. Chinloy [1983] finds that the increase in the proportion of the labour force with post-secondary education has been the main source of the recorded improvement in educational attainment.

The accumulation of human capital depends, of course, not just on the amount of schooling provided, but on the quality of that schooling. The latter has been a main source of concern to some who believe that the increased schooling of the labour force has been at least partly offset by lower educational standards. In the United States, the most pointed support for this position has come from the results of scholastic aptitude tests which demonstrated a decline in the achievement of primary and secondary students over the long period between 1960 and 1980. In Canada, the evidence is more mixed. The Macdonald Royal Commission cites one major survey of Canadian evidence which "found that student performance had improved almost as often as it had declined" [vol. 2, p. 739]. However, the Commission also notes the shifts that have taken place in the thinking of Canadian educators; the trend to more "liberal" education, which was underway in Canadian schools until a few years ago, is now generally perceived to have been undesirable.

Notwithstanding any improvements that are achieved in the quality of schooling,[25] future generations may derive a lower rate of return from their additional investments in human capital simply due to the operation of the law of diminishing returns. The latter suggests that returns will fall as the stock of human capital grows. Recently, however, there has been speculation that returns to increased learning may not decline and, indeed, may even increase. Underlying this line of approach is the finding that knowledge is gained more easily when it is incremental to an existing base of knowledge and skills. The possibility thus arises that, as the stock of human capital grows, further investments will become more productive.[26]

Natural and Environmental Resources

It is useful, as in Section 2, to divide our discussion so as to reflect the dual roles of the environment as a source of resource inputs to the productive process and as a system for the absorption of waste and pollutants.

Resource Supply

In its supply function the environment is subject to the different influences that affect the stock of renewable and non-renewable resources. In the case of *renewable resources*, it should be possible to preserve the value of the stock through appropriate long-term management. In practice, preservation of the

supply of renewable resources has been subject to a number of problems. Renewable resources that are exploited on a common property or open access basis, such as the fishing, are vulnerable to the problems described by the Economic Council [1981] in *Reforming Regulation*. With open entry, an equilibrium will occur when the least efficient fishing units are just earning revenues to cover their opportunity cost. This equilibrium will dissipate the rent that the fishing industry could potentially generate. While the government can set limits on the annual allowable catch so as to preserve the stock and achieve an "optimal sustainable yield," the implementation of an effective system of fishing controls has posed a significant challenge. The resource management problems have been underscored by the recent finding that east coast fish stocks have been greatly overestimated, and that quotas for cod and other species need to be sharply reduced to allow stocks to replenish themselves.

Renewable resources, which are not exploited on a common property basis, are subject to other problems. In the case of forestry, for example, decisions with respect to harvesting and reforestation will be inappropriate to the extent there is no allowance for the recreational, aesthetic, and ecological benefits of the forest. Also, private investments in reforestation which have a very long-term payoff will be inefficient to the extent there is a disparity between private and social discount rates. In Canada over 90 per cent of the forestry is Crown land and thereby ultimately subject to government control. As with fishing, however, it has proven difficult to design a set of arrangements that provide for efficient long-term management of the resource. Poor harvesting and management practices, forest fires, insects, and disease are substantially reducing the forest resources available for future generations. The amount of formerly productive land that has gone into waste has been increasing over time and, at last count, stood at 22 million hectares, or about 10 per cent of Canada's productive forest land.

In the case of *non-renewable resources*, such as fossil fuels and mineral reserves, the question is not whether, but rather the rate at which stocks are being depleted. While "proved" reserves of particular resources may increase through new discoveries and upward revisions of existing estimates, these involve accounting changes as distinct from actual increases in the stock of "nature-made capital." The real value of our resource stocks may increase through increases in the relative price of non-renewable resources, but over time the effect will be to simply slow the rate at which the economy's non-renewable resource wealth is dwindling.

The capital decumulation that occurs in the resource area must be taken into account in calculating the stock of assets that are available to generate income and support consumption in future periods. With an appropriate analysis, estimates of consumption per capita will be reduced to the extent

that the accumulation of reproducible capital is simply a replacement for the loss of finite resources.

The implications of the economy's dependence on finite resources are more serious when we consider the possibility of resource exhaustion in an international context, and when we abandon the more optimistic assumptions about the degree of substitutability between finite resources and other factors of production. Economists have tended largely to downplay the significance of finite resources. This optimism is based, in part, on evidence purporting to show that through increased exploration, technical innovations in the extraction of natural resources, and substitution in the use of resources, increasing natural resource scarcity has been avoided. As well, the general view has been that the elasticity of substitution between natural resources and other factors is, and will continue to remain, well above unity.[27] However, recent studies have found that when relative resource prices are tracked over a long period of time, they do provide some evidence of scarcity.[28] Reviews of the literature, such as that by Smith and Krutilla [1984], show, more generally, that the theoretical and empirical evidence is not able to support the more optimistic views about the capacity of the economy to adjust to resource stringencies. The research does not support the apocalyptic vision of Meadows et al. [1972] who view resource limitations as an absolute constraint on the possibilities for economic expansion. But neither can it provide assurance that the process of adjustment will be smooth and resource limitations will not in the future pose a significant drag on the growth of the economy.

Environmental Quality

The other major consideration in this section pertains to the intergenerational effects of environmental degradation. To the extent that the disposal of wastes and the emission of pollutants is such as to exceed the natural absorptive capacity of the biosphere, future generations will be adversely affected. Environmental impacts will be partly reflected in other components of the nation's wealth: pollution reduces the value of the nation's supply of natural resources; it affects individuals' health and safety and thereby impacts on the stock of human capital; and government requirements to control pollution affect the value of the stock of reproducible capital. But, in addition, the state of the environment including the quality of the air and water, the extensiveness of the wilderness parks, the variety of flora and fauna has a direct bearing on the "quality of life." To the extent the current generation degrades the environment, it is consuming capital much as it would be if it failed to invest an amount sufficient to offset the depreciation of the machinery and factories it inherited.

The reasons why market decisions will lead inadequate resources to be devoted to pollution control have been thoroughly explored in the literature.

Environmental effects are often an "externality" in the sense that the costs do not enter into the books of the firm that is responsible for the damage. While there is an incentive for the responsible firm and those who are affected by its operations to reach a mutually advantageous arrangement, such negotiations may be precluded by the transactions costs and "free rider" problems that complicate efforts to organize and represent the many individuals with an interest in the proceedings. Moreover, to the extent environmental damage occurs over the longer-term, an "externality" may arise because it is future generations that bear the main cost of current activities. The cost to future generations may be especially high where the effects of current environmental use are irreversible.

Recent studies, including, particularly, the report of the World Commission on Environment and Development (the Bruntland Commission), have highlighted a number of disturbing environmental trends. Figure 2 summarizes the main findings of the Bruntland report and of a related report by the United Nations Environment Program [1987]. These global risks are, in many cases, only partially understood. Particular concern has centred on the effect of "greenhouse gases" and on the depletion of the ozone layer. Scientists predict that greenhouse gases (mainly carbon dioxide, but also chlorofluorocarbon methane and nitrous oxide) accumulating in the atmosphere will warm the globe by as much as 4.5°C by the middle of the next century. This could have drastic effects on ocean levels, rainfall, vegetation, and agriculture throughout the world. It is believed that there has already been significant damage to the ozone layer from emissions of chlorofluorocarbons (CFCs) and halons. International agreement has been reached to reduce the use of CFCs, although some scientists question whether the agreed 50 per cent reduction is adequate.

The welfare of future generations depends on the ability of governments to mount a concerted approach to these problems. The future well-being of Canadians will also be determined by the efforts of our own government to address those environmental hazards of special significance in Canada. While there is a potentially long list of such hazards, particular concern has focused on a number of problem areas: the high degree of ozone concentration in urban areas; Canada's carbon emissions, which, per capita, are among the highest in the world; the inadequacy of wastewater treatment facilities; the inadequacy of the controls under the Fisheries Act aimed at the effluents of specific industries; and the lack of policies to effectively protect our fragile northern environment.

Before we can talk with any precision about the intergenerational consequences of environmental trends, it seems that much more information is required than is currently available on the flow of wastes and pollutants from existing activities, on the absorptive and regenerative capacity of the environment, and on the loss in well-being associated with the decline in services

Figure 2

Selected Indicators of Environmental Concerns

Concerns/issues	UNEP (1987) *The State of the World Environment*	World Commission (19[illegible]) *Our Common Future*
Air quality	Mixed trends in *ambient concentrations* of different pollutants	* * *
Global warming	Assuming doubling of CO^2 concentration: increase in *global mean equilibrium surface temperature* by *1.5°C-4.5°C*	By 2030, *between 1.5°C and 4.5°C*
Ozone layer	Total global *ozone reduction* over the next 70 years: about or less than *3 per cent*	* * *
Acid precipitation	No significant change in the *acidity of precipitation* since 1980 (Europe and United States)	Central Europe: receiving more than *1 g of sulphur per ton* annually
Water quality	Mixed trends in *ambient concentrations* of different pollutants	* * *
Water use	In developing countries, *61 per cent of rural population* and *26 per cent of urban population* do not have reasonable access to safe water supply	– Water use: *10 per cent of annual run-off* in Europe and Asia to reach *20-25 per cent* by the year 2000 – *1.7 billion people* lack access to clean water
Desertification	*21 million ha* reduced to a state of near or complete useiessness	*6 million ha* of productive dryland desertified annually
Land loss through soil degradation	*5-7 million ha* of cultivated land lost annually	*544 million ha* lost over the long term
Deforestation	*15 million ha* annually	Over *11 million ha* of forest destroyed annually

Figure 2 (cont'd.)

Concerns/issues	UNEP (1987) *The State of the World Environment*	World Commission (1987) *Our Common Future*
Fisheries	Annual growth rate of world catch, 1950-1970: about *7 per cent*; since 1972, *1-2 per cent*	Annual growth rate of world catch, 1950-1969: *6-7 per cent*; after 1970: *1 per cent*
Extinction of species	*60,000 plant species* in danger of extinction	*Human-caused rate 100 times higher* than natural rate (or possibly 1,000 times)
Protected areas	In 1985, *121 million ha* of biosphere reserves	More than *4 million sq. km* of protected areas
Natural disasters:		
Droughts		In 1970s, *24.4 million people* affected annually
Floods		In 1970s, *15.4 million victims* annually
Urbanization	Between 1970 and 1980: *320 million people* in urban areas; between 1980 and 2000, *1 billion*	Urban population increase: *from 100 million* in 1920 to *1 billion* in 1985
Hazardous wastes	OECD countries: *300 million tons* generated annually	In 1984, *325-375 million tons* generated
Industrial accidents		
Bhopal	* * *	More than *2000 people killed, 200,000 blinded and injured*
Chernobyl	* * *	*Millions of fish killed*
Basel (Sandoz)	*10 tons* of toxic chemical spilled in the Rhine river	

* * * Concern/issue acknowledged or described.
Source Bartelmus [1987*a*].

provided by the environment. But what information is available from recent international surveys indicates that we and other nations are gradually destroying the value of our natural heritage. In the absence of an international commitment to "sustainable development," these studies suggest that we will continue to, in effect, eat into our environmental capital to the detriment of future generations.

Demographic Changes and the Prospects for Today's Young

The young's future well-being – with this defined by per capita consumption as indicated by a measure of economic welfare of the type developed by Nordhaus and Tobin [1972] – depends, in significant part, on the assets and liabilities they will inherit. Therefore in considering the prospects for our children, we should examine the influence of current decisions on Canada's net wealth. A number of the factors relevant to such an examination were discussed in previous sections. Beyond this, however, it is necessary to consider the implications of demographic developments for Canada's future working population.

Projected changes in the size and structure of the population will influence the productive potential of the economy. If other things remain constant, the generally projected slowdown in Canada's population growth should result in an increase in the economy's capital-labour ratio. This, in turn, should raise productivity and per capita income. But, as noted by the OECD [1988], other things may not remain the same.

In particular, there is a need to consider the effect of population ageing on savings rates. Over the next 25 years personal savings rates are likely to increase somewhat due to the growth in the proportion of the population in high savings' age groups. Thereafter, as the baby boom generation moves into the retirement years, personal savings rates should decline, leading to a lower rate of net wealth creation.

It has also been suggested that the slowdown in population growth could adversely affect the rate of technological progress, and that it could lead to a more mature but less adaptable and somewhat less productive workforce. The available evidence as to the overall effect of slower population growth on the economy's productive potential is inconclusive.

Demographic developments will also influence the size and requirements of Canada's non-working population. Canada's dependency ratio is expected to remain relatively stable over the next 25 years as a result of a population decline in the younger age groups which will approximately match the growth in the cohort of the elderly. It is not apparent how this change in structure

will affect the resources that are required to support the dependent population – particularly if we include among these resources the time parents devote to child-rearing and to caring for their own elderly parents.

If we focus solely on the elderly, however, it is clear that the increasing size of this cohort combined with efforts to improve the condition of the elderly will require a growing commitment of economic resources. The rising demands of the elderly will be reflected in the greater dissaving of this cohort (financed by public and private pension plans) and by their increased use of publicly supported goods and services, such as medical care, prescription drugs and public transportation. The rising requirements of the elderly will reduce the share of resources available to meet the needs of other demographic groups. This may impact on the consumption of the working age cohort, or alternatively, on investment, or on the country's foreign indebtedness. In the latter two cases, the impact will spill over onto subsequent generations, who will inherit fewer assets and/or greater liabilities.

The growing demands of the elderly do not in themselves suggest this cohort will constitute a "burden" on the working age population. It may well be that, as a result of savings by the elderly during their working years, the economy will have grown by more than enough to cover the excess consumption of the elderly during their retirement years. Over its life cycle the specific cohort may consume less than it earns. And what we may come to witness is simply the efforts by this cohort to reap some of the benefits of its earlier sacrifices. The consumption opportunities for tomorrow's workers may hence be greater as a consequence of the saving and dissaving of the elderly. Real consumption per capita for tomorrow's workers could conceivably be well above that of the current working population.

Whether this is likely to be the case is difficult to determine, particularly if consumption is given an appropriately broad definition. Prospects for tomorrow's workers are indeed less favourable if, as some have alleged, growing public support for the elderly has been at the expense of public expenditures on children. In the U.S. ostensible support for this argument comes from data indicating that real per capita public expenditures are over three times as high for persons 65 and over as for persons under age 22. But, as Becker and Murphy [1988] show, these numbers are deceiving. The present value of the higher earnings created by the public investment in the young is more than adequate to cover the taxes required to support the elderly. The data is consistent with the notion of a "social compact" in which working adults agree to finance efficient investment in the education of the young, in return for an understanding that they will receive public pensions and medical payments when they are old. Becker and Murphy contend that this social compact contributes to efficient levels of investment in education and support for the elderly, something which, in the absence of government, only richer families could achieve.

Another strand of empirical research has focused more directly on concerns about the cost of supporting the dependent population by attempting to estimate the growth in public spending relative to overall economic growth. Recent projections for Canada suggest that the growth of the economy will be more than adequate to accommodate the increasing demands of dependent groups. Messinger and Powell [1987], for example, find that when the expected growth in real social security spending (which includes OAS/GIS/SPA, CPP/QPP, family allowances, child tax credits, education, unemployment insurance, workman's compensation and social assistance payments) is compared with Informetrica's estimate of real growth, social spending declines from 20.8 per cent of GNP in 1984 to 14.5 per cent in 2011. Fellegi [1988] projects that the real costs per working age person of public spending on health, education, and pensions will grow at an average annual rate of between 1 and 2.3 per cent over the next 50 years. Accordingly, he finds these programs will not increase their claim on the economy if economic growth is comparable to what we experienced over the past 30 years.

The GNP projections on which these studies are based incorporate assumptions about some of the factors we discussed previously in this section. But because of the limitations of GNP, some important aspects of well-being and some important intergenerational transfers will necessarily be ignored. It would be of particular interest to know how the conclusions of these studies would be affected by adjustments to take account of environmental degradation, resource depletion, and those changes in the stock of knowledge that are not reflected in measures of real economic growth. What is disturbing to anyone trying to assess intergenerational trends is that these impacts which are not amenable to quantification, and which may even be difficult to identify, are among the most important. Moreover, some of the main intergenerational transfers are beyond the control of Canadians. General advances in science and in applying scientific knowledge and the progress of nations in developing a cooperative strategy for responding to the long-term threats to the earth's ecological system will greatly influence the fate of future generations of Canadians.

The Role for Government

General Considerations

It has long been recognized that, even if all the usual assumptions about competitive behaviour are satisfied, there is no guarantee the market will allocate resources efficiently over time.[29] Malvinaud [1953] showed that the efficient results that characterize equilibrium in a competitive economy cannot be expected to necessarily hold when we extend the allocation problem from a finite to an infinite horizon. Moreover, the economy is beset by a

number of market failures which distort the allocation of resources and have important implications for the well-being of future generations.

There is still the question as to whether, and to what extent, governments can improve upon things. Government intervention is subject to a number of well-known limitations. Even if governments did assign a high priority to the interests of future generations, inadequate information and problems of bureaucratic management and control would limit their ability to efficiently and effectively pursue this objective. However, there is reason to question how well the interest of future generations are represented in the political process. According to one prominent view, Canada's political system is largely oriented to satisfying the needs of well-organized special interests and of those who are directly involved in the policy-making process, this at the expense of broadly based, longer-term public concerns, including the well-being of future generations. Further, there remains the challenge posed by those models in which utility depends not only on individuals' own consumption, but also that of their children and their children's children, etc., i.e., Barro [1974]. Under these circumstances, public policies to transfer resources between generations are unnecessary. They are also ineffective; changes in intrafamily transfers will "neutralize" the effects of government policies so as to leave the position of each generation unchanged.

With respect to the latter, the available empirical evidence suggests that, although bequests provide an important link between generations, neutrality or Ricardian equivalence doesn't hold exactly.[30] And, while individual altruism is not as strong, collective altruism is not as weak as the critics of government intervention would suggest. The strength of the environmental movement suggest that, at least in the current period, some of the vital concerns of future generations are being well represented in policy debates. The inefficiencies associated with government intervention must also be put in perspective. Where market failures entail a substantial cost, even badly designed and administered policies may result in significant benefits.

Of course, governments do intervene, and, in the Canadian economy, government policies have a considerable influence on the size and nature of our bequest to future generations. The challenge is to improve upon that intervention so governments are more effective custodians of the interests of future generations. In what follows, we address three aspects of this issue. First, there is a need to get a realistic sense of the government's ability to plan for the future. By way of illustrating the limits of intervention we consider policies intended to respond to the uncertainty that characterizes the future. Second, there is a need to address gaps and shortcomings among the existing range of policies that impact on the well-being of future generations. This is a large topic and our intention is simply to convey some idea of the scope for reform. Third, we will broach, what some believe to be, the more fundamental issue

concerning limitations in the political process itself. Is it possible to reform the political process so as to ensure adequate attention to the interests of future generations?

Uncertainty and the Limits of Intervention

In making long-term decisions, individuals face many forms of uncertainty. Planning is complicated by uncertainties relating, for example, to the future trend in prices, the length of an individual's life, his lifetime income, and the degree of support his children will require. With better knowledge about the trend in real income and prices, parents might alter the nature of their bequest[31] and firms might change the form and timing of their investments. The pace of resource extraction would, in some instances, be very different if owners of the asset had better information on the prospects for resource prices. More generally, one might expect that our ancestors would have saved less and consumed more had they foreseen the technological progress that has made us a comparatively prosperous generation.

The existence of such uncertainties does not in itself provide a rationale for government intervention. Part of the problem relates to the basic fact that the future is unknowable. As a result, it is inevitable that decisions taken today will be found ex post facto to be highly imperfect. But it is not clear that the government has a better crystal ball than individual market participants and that government intervention would, on this basis, contribute to greater intergenerational efficiency and equity. It could be argued, on the contrary, that systematic errors in forecasting are less likely when the varying judgments of individuals are systematically aggregated as they are in the market. Moreover, there are strong incentives within the market to discover any systematic errors in forecasting that do arise. Within the public sector, the implications of the reward and incentive structure tend to be less clear.

There is another possible justification for government intervention, which is based on the view that the public sector can reduce the costs of bearing risks and that it can do so better than the private sector. The argument that the public sector can achieve economies in the costs of bearing risk has been used to justify direct state involvement in high risk projects.[32] It has also provided support for the development of various programs of public insurance. For example, it has been shown that a public risk pooling scheme in which participation is compulsory can overcome the problem of "adverse selection" that arises where it is difficult for an insurer to detect the risk class into which individuals fall.[33] In many cases, however, the problems that prevent private markets from responding to the demand for risk reduction will also beset the public sector. Where the cost of assembling risk capital to pursue certain high risk projects is prohibitive because of monitoring and control problems, public involvement may not offer any advantages.[34] Similarly, where private

insurance is precluded because of "moral hazard" problems, public insurance will often also be uneconomic.[35] One consequence of such problems is that futures markets, which provide insurance against the uncertainty of price movements, are extremely limited both in number and scope.

While social insurance programs allocate risk among members of a given population, a recent study explores the possibility of government serving as a vehicle of intergenerational risk-sharing. Gordon and Varian [1985] suggest that debt and tax-transfer policies can be used to pool the risks faced by different generations. Debt-finance, for example, would enable later generations to assist unlucky generations that experience wars and severe recessions. In a similar vein, Modigliani [1986] has suggested that when a generation undertakes a major expenditure whose benefits will be distributed over the future (such as a war), deficit financing is appropriate. However, as Burbidge [1987] notes, there is an assumption in the model of intergeneration risk-sharing that the probabilities attached to positive and negative shocks are well known. In practice, the scope for intergenerational risk-sharing is limited by the fact we do not know, and cannot know, whether we are "lucky" or "unlucky" as compared to those generations that will proceed us.

The Scope for Policy Reform

A wide range of government policies and programs impact on our bequest to future generations. Federal and provincial governments are directly involved in asset creation through the investment activities of their departments, agencies, and corporations; "public infrastructure capital" (including, for example, roads and waste disposal facilities) and the human capital that is created through public investment in health and education are important components of the country's overall capital stock. Through their spending and financing decisions governments will also have an important direct influence on the nation's foreign indebtedness. Indirectly, governments will exercise influence through a variety of policies that impact on private sector savings and investment decisions. The rate of private sector savings – and the country's consequent dependence on foreign savings – will be influenced by the form and level of taxation and the financing arrangements for public pension plans.[36] And government policies with respect to taxation, subsidies, and regulations will have an important influence on the allocation of capital between regions, sectors, and activities. Incentives to encourage activities deemed to be socially desirable, such as research and development, and penalties and sanctions to discourage "undesirable" activities, such as pollution, will impact on both the quantity and quality of the nation's capital stock.

Our assessment of government intervention ultimately depends on our assessment as to whether net wealth creation by the public and private sectors

is consistent with our obligation to future generations. The problems that beset attempts to address this broader question were discussed in previous sections of the paper. To the extent wealth creation by the current generation is judged to be inadequate, then there is reason to look at the reforms needed to generate increased national savings. One of the most promising ways for governments to increase national savings is to increase their own savings or to reduce their dissavings. As always, however, savings must be broadly and properly measured. What is of potential concern is the borrowing by the public sector that goes towards supporting consumption by the current generation. The government deficit, by contrast, measures the balance from both government current and capital transactions.

Whatever we conclude about the adequacy of the sacrifices by the current generation, there is reason to be concerned about government policies that result in waste or a misallocation of resources. A variety of evidence – such as the Economic Council [1981, 1983, 1986, and 1987] – suggests there is considerable scope for improvement; governments could do much more to enhance the possibilities for wealth creation consistent with society's choices between savings and current consumption.

Concern has focused in part on governments' own investment activities – on the inadequate social return from public investment in infrastructure, human capital and the fixed capital of public corporations. As well, there are those distortions arising from the influence of public sector incentives and constraints on the activities of firms and individuals. Fiscal and regulatory measures are, of course, often motivated by redistributive objectives, in which case their economic consequences may be assigned little or no importance. There is evidence, for example, that agricultural supports and subsidies significantly undermine wealth creation both, directly, by encouraging intensive farming that leads to soil degradation, and indirectly, by reducing national output and, thus, the resources available for investment. However, even where market failures exist and are an important consideration, concerns have arisen about the cost and effectiveness of government intervention. For example, some of the most serious problems of wealth accumulation are the result of property right structures that are in some sense incomplete. For markets to exist and to operate efficiently, property rights must be well defined, effectively enforced, and freely transferable. But, as we saw in previous sections, government intervention where these conditions do not exist – as, for example, in the fishery and the forests – leaves much to be desired.

The influence of the public sector is likely to be particularly important where decisions entail very long-term consequences which private sector decision makers would tend to ignore or heavily discount. Many would agree with Ramsey [1928] that the use of a positive discount rate to evaluate benefits and costs passed on to future generations is ethically indefensible. It is true,

as Myrick Freeman [1977] points out, that the exponential arithmetic of discounting works both ways; the effect of discounting is to trivialize not just future damages, but also the amount that must be invested today and cumulated forward to pay appropriate compensation to future generations. But given the practical difficulties in implementing a system of compensation which would make a decision with long-term negative effects agreeable to all generations, the use of a positive rate of time preference will penalize future generations.

Where current decisions result in long-term damage that is irreversible, future generations in effect incur a double penalty. They must not only bear the costs of the damage, but they are also denied the option of rectifying the situation. When evaluating the effect of current decisions which could lead to the destruction of irreplaceable national assets, it is generally agreed that an extra cost (or "option value") should be added to the expected value of future damages. As well, allowance must be made for the possibility that future generations will place a higher value on these assets than the current generation; due to this uncertainty regarding future tastes, a further addition must be made in the calculation of expected future damages.

Some would argue that, for some components of the nation's wealth, these considerations are so important that the state should assume a "stewardship" role. Osberg [1985] has observed that the concept of a "national heritage" suggests that there are goods whose social worth cannot even be approximated by current market prices and that should be held in trust for future generations. While environmentalists are concerned with natural resources, plant and animal species, and man-made objects of great beauty or historical significance, our heritage can be defined to also include fundamental social and political values such as the basic freedoms and rights enshrined in the Constitution.[37]

Reform of the Political Process

In the view of some advocates of reform, the shortcomings of government policy are symptomatic of some serious biases within the policymaking process. The current system is seen to afford inordinate influence to well-organized interest groups that can effectively play upon the self-interest of politicians and bureaucrats. What is required, it is therefore argued, are process reforms designed to reduce or offset the influence of such special interests.

It is in this context that various proposals have been put forward to open up the policy-making process and to provide for greater consultation and more systematic analysis of new policies and regulations. One response has been to require major federal regulatory proposals to undergo a socio-economic

impact analysis and to satisfy requirements for public notification and consultation. Similarly, major projects requiring federal approval may be required to pass an environmental assessment review, which could include an elaborate process of public hearings. Such requirements help to ensure that issues of broad public concern are at least considered in the decision-making process. They may also affect the way in which policymakers interpret their own self-interest; as decision making becomes more transparent, policymakers may find that their personal prospects are less clearly tied to the rent-seeking objectives of sectoral interest groups.

The influence of environmental and other public interest groups may also be increased through public funding. This is seen to be justified by the inherently precarious financial position of interest groups that seek to represent large numbers of individuals, each of whom has a relatively small stake in the relevant policy or regulatory decisions. Public support can improve the position of these groups vis-à-vis narrow-based interest groups that tend to be well financed and well represented, and thereby contribute to a more balanced public debate.

To some observers, such reforms are an inadequate response to the political pressures on governments to distribute favours and to ignore the associated long-run costs. Buchanan, Rowley, and Tollison [1988] believe that the interests of future generations must be safeguarded within the constitution. Their specific concern is with the deficit spending of the U.S. federal government, which they regard partly as a consequence of self-seeking behaviour by politicians and government officials, but also as a reflection of the general weakening of family-based concern for future generations. They see the solution in a constitutional amendment mandating a balanced federal budget. However, a constitutional convention aimed at protecting the interests of future generations need not be confined to budgetary matters. It could attempt to define the range of values that are central to sustaining economic growth and market and non-market consumption opportunities. While this is obviously a daunting task, what is significant is the opportunity a constitutional convention affords for a broad representation of views and interests within an environment where decision makers are infused with a sense of the high moral purpose for which they have been convened.

Conclusions

The welfare of future generations has become an issue of increasing concern. Given the performance of the economy over the last decade and a half, it is now much less certain to what extent future generations will benefit from continuing improvements in productivity. At the same time, the liabilities being passed on to future generations in the form of public debt and environmental and other social costs appear to be growing at an alarming pace. There

is concern that, in the immediate future, the costs of supporting a growing elderly population will add further to the burden facing Canada's future workers. A review of the literature helps clarify the relevant issues, but it also highlights some severe conceptual and empirical problems which limit our ability to evaluate these concerns.

A major problem is the lack of a satisfactory measure by which to assess the position of one generation relative to another. GNP, both because of what it includes and what it ignores, is a seriously misleading indicator of changes in economic welfare. Attempts to develop a "measure of economic welfare" and to construct a meaningful set of social indicators have been criticized because, in both cases, results are highly sensitive to judgments made by the researcher. A seemingly more feasible approach is to measure the net stock of wealth being passed on to support the consumption of succeeding generations. But the development of a suitably comprehensive, quality-adjusted measure of Canada's capital stock is itself subject to serious problems of both an empirical and conceptual nature.

In the absence of a useful overall measure of intergenerational changes or impacts, we may nonetheless attempt to understand how current decisions will affect the opportunities of future generations. From this perspective, there are a number of developments which are a potential source of concern: the significant growth in the federal deficit since the mid-1970s; perceived changes in the quality of primary and secondary education; the difficulties encountered in the management of Canada's renewable resources; and the environmental degradation resulting from both local hazards and the global contaminants that pose a long-term threat to the earth's ecological systems. To understand the latter and arguably most serious development, information is required on the flow of waste and pollutants from existing activities, on the absorptive and regenerative capacity of the environment, and on the loss in well-being associated with the deterioration in environmental quality.

Economic analysis per se can make more of a contribution in helping us understand concerns pertaining to the public debt and the adequacy of domestic savings. Recent studies suggest that while private saving may increase to offset some of the public dissaving, individuals do not fully take account of the future taxes required to service the increase in the national debt. Hence, in an open economy, an increase in the public debt will lead to a somewhat greater reliance on foreign savings. To the extent this occurs and the debt is not associated with a parallel growth in the country's productive assets, the growing public debt will impinge on the welfare of future generations.

The specific concern that the growing proportion of elderly will impose a burden on Canada's future working population has been examined empirically. Available projections suggest that the real growth of the economy will

be adequate to cover the growth in real social security spending. However, these projections do not take account of the impact of demographic developments on the economy's productive potential, and they ignore some of the important social costs that are being passed on to future generations. To assess whether the elderly are likely to constitute a "burden," it is necessary to consider not only the contribution this cohort will have made to the accumulation of income-producing assets, but also the damage it will have caused to other aspects of the nation's wealth.

Left to its own, there is no reason to expect that the market will allocate resources over time either efficiently or equitably. This would be the case even if the usual assumptions about competitive behaviour were satisfied. But these assumptions are not satisfied and the "market failures" which are of concern to the current generation are also a problem in terms of the intertemporal allocation of resources; as a consequence of these failures capital accumulation will depart from what is socially optimal. In addition, the tendency of market participants to heavily discount costs and benefits that impact on future generations is highly questionable in ethical terms. But while intergenerational considerations suggest that there is a rationale for government intervention, the attempt to define a policy role raises some very difficult questions: How can the resources, institutions and values that constitute our "national heritage" be identified? Is a principle of egalitarianism an appropriate guide to our obligations to future generations, or ought we to plan our investment so as to allow future generations to benefit from technological progress? And in so far as the rate of wealth accumulation, broadly defined, is judged to be inadequate, what type of intervention and what reforms to existing policies are most likely to contribute to improving the welfare of future generations of Canadians? These questions suggest the basis for a challenging research agenda.

Notes

1 This was a major point of debate between proponents of the "limits to growth" theory, such as Forrester [1971] and economists such as Nordhaus [1972]. The latter argued that as essential resources are depleted, their prices will rise forcing entrepreneurs to search for cheaper substitutes.

2 Rawls in fact regards the "max-min" principle as being inapplicable to intergenerational (as distinct from intragenerational) equity. The complicating factor is that exchanges between generations can occur only in one direction: We can do something for posterity, but it can do nothing for us. As a consequence, Rawls opts for a vaguer principle which involves a balance between what a person demands of his parents and what he is prepared to do for his children.

3 This means that if the capital stock is not initially large enough to support a decent standard of living, the "max-min" principle leads to the perpetuation of poverty. But, as Solow points out, it's unclear why the initial capital stock should even have been accumulated.

4 Efficient exploitation of an exhaustible resource requires that extraction occur as long as the interest rate, or the return on reproducible capital, exceeds the capital gain from holding deposits.

5 Mishan [1984] believes that the growth of real GNP per capita has been substantially overestimated due to: the failure to value housework; the over-valuation of public sector production; the inclusion of military spending in GNP; and inadequate accounting for the exploitation of irreplaceable resources and for environmental pollution.

6 With no technological change, the growth in capital must keep pace with the growth in the labour force to sustain per capita consumption. With technological progress, however, a given level of consumption per capita could be sustained with a decline in the capital-output ratio. The calculation adopted for CC_g would lead to consumption per capita growing with the rate of technological progress.

7 See, for example, the *11th Annual Review*, Economic Targets and Social Indicators, 1974.

8 This is described in Lemaire [1987].

9 In the national accounts there is an imputation for the value of rental services provided by owner-occupied homes. However, there is no similar

imputation for the income and consumption provided by other types of capital.

10 While changes in wealth, strictly defined, include capital gains, the latter may not represent an improvement in the prospect of future generations. Capital gains may not be due to market developments but to changes in expectations. If an adjustment for capital gains is included, therefore, we may find our estimate of national wealth has increased in a given year though in real terms nothing has changed. Should capital gains be included, the effect would be to substantially increase the size of the capital stock. Robert Eisner [1980] has estimated that over the period 1946 to 1975, the inclusion of real capital gains would increase measured investment growth in the U.S. by some 40 per cent.

11 A useful collection of articles on both sides of the Cambridge controversy is contained in Harcourt and Laing [1971].

12 The "average economic life data" used in the estimation of the capital stock, for example, are suspect. As well, many of the deflators used are believed to make inadequate allowance for the improved quality of new investment. See Gordon J. Garston [1983].

13 The conceptual problems associated with measuring natural resource and environmental capital are addressed in Hartwick [1989]. The focus of this paper is on the development of appropriate measures of resource and environmental depreciation to be incorporated in a revised, more comprehensive and correct measure of net national product.

14 See, for example, Peter Peterson [1987].

15 Feldstein and Horioka [1980] have noted that for developed countries the share of savings and capital formation in output tend to be very similar. However, as Purvis [1985] notes, this should not be taken as evidence of a lack of international capital mobility. It could, for example, reflect the importance governments attach to achieving current account balance.

16 This is supported by the empirical evidence assembled by Boothe et al. [1985].

17 The adjustments required for an open economy are examined in Purvis [1985].

18 The more relevant concern could indeed be the inadequacy of public sector investment. It has been argued, for example, that the United States has allowed its "public infrastructure capital" (i.e., roads, bridges, mass

transit systems, water and sewer facilities) to badly deteriorate. Hulten and Peterson [1984] find that a high proportion of the capital stock has reached the end of its planned life and now requires replacement or more intensive maintenance and repair. However, current problems are partly a consequence of the overinvestment that occurred in the late 1950s and early 1960s. This in turn was a result of highly optimistic expectations for continued U.S. growth and the strong investment incentives that are incorporated in the United States' federal grant program. Hulten and Peterson point out that "the infrastructure problem is misrepresented when interpreted as resulting from long-term, persistent underinvestment in the state and local sector" [p. 172].

19 As Purvis [1985] notes, the net foreign indebtedness of the economy may increase by more than the rise in the public debt. The higher taxes required to service the public debt will reduce after-tax income and this, in turn, may lead to a fall in personal savings.

20 An interesting study by Carroll and Summers [1987] attempted to determine whether the sudden and dramatic divergence in Canadian and U.S. private savings rates that occurred over 1975 to 1985 could, indeed, be related to differences in fiscal policy. The authors found that while the greater increase in the budgetary deficit in Canada served as one possible explanation of Canada's higher savings rate, the evidence was not entirely supportive of Barro's thesis. Contrary to Barro's model, the private savings rate in the U.S. declined in the early 1980s as the U.S. government deficit mushroomed to unprecedented proportions.

21 This is based on discussions at the "International Seminar on Science Technology and Economic Growth," OECD, Paris, June 1989.

22 In this regard, the recent labour market difficulties experienced by the parents of young children is of some significance. Between 1967 and 1987, the average real income of families with parents aged 25 to 34 increased only marginally, and even this was only possible because of the growth in two-worker families. While this may reduce expectations about the prospects for the next generation – which as Drazen [1978] shows can have a positive influence on the amount of a bequest – the more immediate result is that parents have less time to devote to child-rearing, and adequate child-care entails a significant financial burden for young families.

23 Becker and Murphy [1988] focus on the rationale for public investment in education. But in the model constructed by Drazen [1978], the significance of government arises from the existence of government bonds. The latter is a mechanism for negative bequests. The possibility of

imposing a liability on one's children allows less altruistic parents to invest optimally in their offspring's education.

24 The importance of this was impressed upon me by Lars Osberg.

25 However, the factors that contribute to more effective schooling are poorly understood. In his review article, Hanushek [1986] notes that "the constantly rising costs and 'quality' of inputs of schools appear to be unmatched by improvement in the performance of students." Differences in the performance of students do not seem to reflect variations in expenditures, class sizes, teacher training or other commonly measured attributes of schools and teachers. What appears to be most important are "differences in teacher 'skills' that defy detailed description, but that possibly can be observed directly."

26 This possibility is raised in Becker [1988] and it is explored in a number of recent growth models. An example of the latter is Romer [1986].

27 The assumption of near-perfect substitutability is implied in the common practice of econometricians to estimate aggregate production using labour-capital functions. To sustain constant per capita consumption the elasticity of substitution must be greater than unity, or it must be equal to unity and the share of capital must exceed that of natural resources.

28 An example is the study by Slade [1982]. Recent evidence contradicts the widely cited findings of Barnett and Morse [1963] on the long-term stability of relative resource prices.

29 With an "efficient" allocation of resources, it is not possible to increase the welfare of one generation without reducing that of some other generation.

30 For a recent discussion, see Boskin [1988].

31 As noted previously, Feldstein [1988] has shown that when future earnings are uncertain, bequests are also uncertain, and Ricardian equivalence does not hold.

32 The reference here is to the argument developed by Arrow and Lind [1970].

33 Whinston [1983], for example, has developed an argument for social insurance where workers face uncertainty about their physical ability to work and the government is unable to distinguish between workers in terms of their probability of becoming disabled.

34 This is discussed by McFetridge [1977].

35 A "moral hazard" problem exists where it is very difficult to enforce a contract so as to prevent the insured party from deliberately bringing about the event that would give rise to an insurance payment. Moral hazard prevents the introduction of insurance to reduce the uncertainty with respect, for example, to an individual's future income.

36 The impact of the tax system is analysed in Economic Council of Canada [1987].

37 Osberg [1985] notes that the argument for preserving fundamental rights and values rests partly on the belief that these will be beneficial to our descendants and partly on our desire to promote cultural continuity. The latter suggests a possibility for abuse: "The notion of a national heritage . . . can be extended to justify preserving 'life as we have always known it'" [p. 55].

Bibliography

Arrow, K. J., and R. C. Lind [1970]. "Uncertainty and the evaluation of public investment decisions." *American Economic Review* 60, p. 364-78.

Atkinson, A. B. [1987]. "Income maintenance and social insurance." In *Handbook of Public Economics*, eds. Alan J. Auerbach and Martin Feldstein, Volume 2. Amsterdam: North Holland.

Barnett, Harold T., and Chandler Morse [1963]. *Scarcity and Growth: The Economics of Natural Resource Availability*. Baltimore: John Hopkins University.

Barro, R. J. [1978]. *The Impact of Social Security on Private Saving: Evidence from the U.S. Time Series*. Washington, D.C.: American Enterprise Institute for Public Policy Research.

_____ [1974]. "Are government bonds net wealth?" *Journal of Political Economy* 82, p. 1095-117.

Bartelmus, Peter [1987*a*]. "Accounting for sustainable development." Working Paper No. 8, Department of International Economic and Social Affairs, United Nations.

_____ [1987*b*]. "Beyond GDP – New approaches to applied statistics." *The Review of Income and Wealth* 33, p. 347-58.

Beach, Charles M., Robin Boadway, and Jack Gibbons [1984]. "Social security and aggregate capital accumulation revisited: Dynamic simultaneous estimates in a wealth-generation model." *Economic Inquiry* 22, p. 68-79.

Becker, Gary S. [1988]. "Family economics and macro behaviour." *The American Economic Review* 78, p. 1-13.

Becker, Gary S., and Kevin Murphy [1988]. "The family and the state." *Journal of Law and Economics* 31, p. 1-18.

Bernheim, Douglas, Andrei Shleifer, and Lawrence Summers [1984]. "Bequests as a means of payment." NBER Working Paper No. 1303, National Bureau of Economic Research, Cambridge, Mass.

Boothe, Paul, Kevin Clinton, Agathe Côté, and David Longworth [1985]. "International asset substitutability." In *Post-War Macroeconomic Developments*, Volume 20 of the research studies prepared for the Royal

Commission on the Economic Union and Development Prospects for Canada. Toronto: University of Toronto Press.

Boskin, Michael J. [1988]. "Consumption, saving and fiscal policy." *American Economic Association Paper and Proceedings* 78, p. 401-7.

Buchanan, James M., C. K. Rowley, and R. D. Tollison [1987]. *Deficits*. New York: Basil Blackwell.

Burbidge, John [1987]. *Social Security in Canada: An Economic Appraisal*. Toronto: Canadian Tax Foundation.

Carroll, Chris, and L. H. Summers [1987]. "Why have private savings rates in the United States and Canada diverged?" *Journal of Monetary Economics* 20, p. 249-79.

Chinloy, Peter [1983]. "Labour quality change in Canada." Discussion Paper No. 231, Economic Council of Canada, Ottawa.

Courant, Paul, Edward Gramlich, and John Laitner [1986]. "A dynamic micro estimate of the life cycle model." In *Retirement and Economic Behaviour*, eds. H. J. Aaron and G. Bartless. Washington, D.C.: Brookings Institution.

Dagenais, Marcel G. [1989]. "Measuring personal saving, consumption and disposable income, in Canada, since 1962." Working Paper No. 8942, Economics Department, University of Montreal.

Dasgupta, P., and G. Heal [1974]. "The optimal depletion of exhaustible resources." *Review of Economic Studies* 41, supplement, p. 3-28.

Davies, James B. [1982]. "The relative impact of inheritance and other factors on economic inequality." *The Quarterly Journal of Economics*, August.

Davies, James B., and France St-Hilaire [1987]. *Reforming Capital Income Taxation in Canada*. Economic Council of Canada. Ottawa: Supply and Services Canada.

Denny, Michael [1986]. "The prospects for productivity." In *Economic Growth: Prospects and Determinants*, Volume 22 of the research studies prepared for the Royal Commission on Economic Union and Development Prospects for Canada. Toronto: University of Toronto Press.

Drazen, Allan [1978]. "Government debt, human capital, and bequests in a life-cycle model." *Journal of Political Economy* 86, p. 505-16.

Economic Council of Canada [1987]. *The Taxation of Savings and Investment*. Ottawa: Supply and Services Canada.

_____ [1986]. *Minding the Public's Business*. Ottawa: Supply and Services Canada.

_____ [1983]. *The Bottom Line: Technology, Trade and Income Growth*. Ottawa: Supply and Services Canada.

_____ [1981]. *Reforming Regulation*. Ottawa: Supply and Services Canada.

_____ [1974]. *Economic Targets and Social Indicators*, Eleventh Annual Review. Ottawa: Supply and Services Canada.

Eisner, R. [1980]. "Capital gains and income: Real changes in the value of capital in the United States, 1946-75." In *The Measurement of Capital*, ed. D. Usher, NBER Conference on Income and Wealth. Chicago: University of Chicago Press.

Feldstein, Martin [1988]. "The effects of fiscal policies when incomes are uncertain: A contradiction to Ricardian equivalence." *The American Economic Review* 78, p. 14-23.

_____ [1974]. "Social security, induced retirement, and aggregate capital accumulation." *Journal of Political Economy* 82, p. 905-26.

Feldstein, Martin, and C. Horioka [1980]. "Domestic savings and international capital flows." *Economic Journal* 90, p. 314-29.

Fellegi, Ivan P. [1988]. "Can we afford our aging society." *Canadian Economic Observer*, October.

Ferguson, James M., ed [1964]. *Public Debt and Future Generations*. Chapel Hill: The University of North Carolina Press.

Forrester, J. W. [1971].*World Dynamics*. Cambridge, Mass.: Wright-Allen Press Inc.

Freeman, A. Myrick, III [1977]. "Equity, efficiency, and discounting: The reasons for discounting intergenerational effects." *Futures* 9, p. 375-76.

Friend, Anthony, M. [1986]. "Natural resource accounting and its relationship with economic and environmental accounting." Discussion Paper, Statistics Canada.

Garston, Gordon J. [1983]. "Canada's capital stock." Discussion Paper No. 226, Economic Council of Canada, Ottawa.

Gordon, Roger H., and H. R. Varian [1985]. "Intergenerational risk sharing." NBER Working Paper No. 1730, National Bureau of Economic Research, Cambridge, Mass.

Griliches, Zvi, ed. [1984]. *R&D, Patents and Productivity*. Chicago: University of Chicago Press.

Grossman, Herschel [1982]. "The American fiscal deficit: Facts and effects." NBER Working Paper No. 934, National Bureau of Economic Research, Cambridge, Mass.

Hankiss, E. [1983]. "Cross-cultural quality of life research: An outline for a conceptual framework." In *Quality of Life: Problems of Assessment and Measurement*, Socio-Economic Study No. 5. Paris: UNESCO.

Hanushek, Eric A. [1986]. "The economics of schooling." *Journal of Economic Literature* 24, p. 1141-77.

Harcourt, G. C., and N. F. Laing, eds. [1971]. *Capital and Growth*. Harmondsworth: Penguin.

Hartwick, John M. [1989]. "Allowing for economic depreciation of natural resource stocks in national accounting and sustainable development." Economic Council of Canada, Ottawa, mimeo.

_____ [1977]. "Intergenerational equity and the investing of rents from exhaustible resources." *The American Economic Review* 67, p. 972-74.

Hulten, Charles R., and G. E. Peterson [1984]. "The public capital stock: Needs, trends and performance." *American Economic Association Papers and Proceedings* 74, p. 166-73.

Italiano, Joe [1988]. "Movements in the personal savings rate." *Quarterly Economic Review*, Department of Finance, June.

Jorgenson, Dale W., and Barbara Fraumeni [1987]. "The accumulation of human and non-human capital, 1948-1984." Harvard Institute of Economic Research, Cambridge, Mass., mimeo.

Jump, G. V. [1983]. "Financing public pensions: Some capital market implications." Ontario Economic Council, Toronto, mimeo.

Jump, G. V., and Thomas Wilson [1986]. "Savings in Canada: Retrospective and prospective." In *Economic Growth: Prospects and Determinants*, Volume 22 of the research studies prepared for the Royal Commission on

Economic Union and Development Prospects for Canada. Toronto: University of Toronto Press.

Juster, F. Thomas, P. N. Courant, and G. K. Dow [1981]. "The theory and measurement of well-being: A suggested framework for accounting and analysis." In *Social Accounting Systems*, eds. F. T. Juster and K. C. Land. New York: Academic Press.

Kendrick, John W. [1976]. *The Formation and Stocks of Total Capital*. New York: National Bureau of Economic Research.

Keynes, J. M. [1936]. *General Theory of Employment, Interest and Money*. New York: Harcourt, Brace.

Kosters, Marvin H., and M. N. Ross [1988]. "A shrinking middle class?" *The Public Interest*, Winter, p. 3-27.

Kotlikoff, Laurence, and A. Spivak [1981]. "The family as an incomplete annuities market." *Journal of Political Economy* 89, p. 372-91.

Kotlikoff, Laurence, and L. Summers [1981]. "The importance of intergenerational transfers in aggregate capital accumulation." *Journal of Political Economy* 89, p. 706-32.

Leimer, D. R., and S. D. Lesnoy [1982]. "Social security and private savings: New time series evidence." *Journal of Political Economy* 90, p. 606-29.

Lemaire, M. [1987]. "Satellite accounts: A relevant framework for analysis in social fields." *The Review of Income and Wealth* 33, p. 305-26.

Lerner, A. P. [1948]. "The burden of the national debt." In *Income, Employment and Public Policy: Essays in Honor of Alvin Hansen*, eds. L. Metzler et al. New York: W. W. Norton.

Malvinaud, E. [1953]. "Capital accumulation and efficient allocation of resources." *Econometrica* 21, p. 233-68.

Mansfield, Edwin [1983]. "Long waves and technological innovation." *American Economic Association Papers and Proceedings* 73, p. 141-5.

Maynard, R. [1988]. "How rich are we?" *The Globe and Mail, Report on Business Magazine*, May.

McFetridge, D. [1977]. *Government Support of Scientific Research and Development: An Economic Analysis*. Toronto: Ontario Economic Council.

Meadows, D. H. et al. [1972]. *The Limits to Growth*. New York: Universe Books.

Messinger, H., and B. Powell [1987]. "The implications of Canada's aging society on social expenditures." Department of National Health and Welfare, Ottawa, mimeo.

Mishan, E. J. [1984]. "GNP – Measurement or mirage?" *National Westminster Bank Quarterly Review*, November.

_____ [1977]. "Economic criteria for intergenerational comparisons." *Future* 9, p. 383-403.

Modigliani, Franco [1988]. "The role of intergenerational transfers and life cycle saving in the accumulation of wealth." *Journal of Economic Perspectives* 2, p. 15-40.

_____ [1986]. "Comment on R. J. Barro, U.S. deficits since World War I." *The Scandinavian Journal of Economics* 88, p. 223-34.

Nasar, S. [1987]. "Do we live as well as we used to?" *Fortune*, September 14.

Nordhaus, W. D. [1972]. "World dynamics: Measurement without data." Cowles Foundation Discussion Paper.

Nordhaus, W. D., and J. Tobin [1972]. "Is growth obsolete?" In *Economic Growth*, Fiftieth Anniversary, Colloquium V. New York: National Bureau of Economic Research.

OECD [1988]. "Ageing populations; implications for public finance and the macroeconomy." Working Party No.1 of the Economic Policy Committee.

Osberg, Lars [1985]. "The measurement of economic well-being." In *Approaches to Economic Well-Being*, Volume 26 of the research studies prepared for the Royal Commission on the Economic Union and Development Prospects for Canada. Toronto: University of Toronto Press.

Peterson, Peter [1987]. "The morning after." *The Atlantic Monthly*, October.

Purvis, Douglas P. [1985]. "Public sector deficits, international capital movements and the domestic economy: The medium term is the message." *Canadian Journal of Economics* 18, p. 723-42.

Ramsey, F. [1928]. "A mathematical theory of saving." *The Economic Journal* 38, p. 543-59.

Rawls, J. [1971]. *A Theory of Justice*. Cambridge, Mass.: Harvard University Press.

Romer, Paul M. [1986]. "Increasing returns and long-run growth." *Journal of Political Economy* 94, p. 1002-37.

Royal Commission on the Economic Union and Development Prospects for Canada [1985]. *Report*, Volume 2. Ottawa: Supply and Services Canada.

Samuelson, P. A. [1975]. "Optimum social security in a life-cycle growth model." *International Economic Review* 16, p. 539-44.

Slade, Margaret F. [1982]. "Trends in natural resource commodity prices: An analysis of the time domain." *Journal of Environmental Economics and Management* 9, p. 122-37.

Smith, V. Kerry, and J. V. Krutilla [1984]. "Economic growth, resource availability and environmental quality." *American Economic Association Papers and Proceedings* 74, p. 226-30.

Solow, R. M. [1974]. "Intergenerational equity and exhaustible resources." *The Review of Economic Studies*, Symposium, p. 29-46.

United Nations [1978]. *Social Indicators: Preliminary Guidelines and Illustrative Series*, No. E.79.XVII.4. New York: United Nations.

_____ [1977]. *The Feasibility of Welfare-Oriented Measures to Supplement the National Accounts and Balances: A Technical Report*, No. E.77.XVII.12. New York: United Nations.

United Nations Environment Programme [1987]. *Environmental Data Report*. New York: Basil Blackwell.

Venti, Steven F., and D. A. Wise [1989]. "But they don't want to reduce housing equity." NBER Working Paper No. 2859, National Bureau of Economic Research, Cambridge, Mass.

Whinston, Michael D. [1983]. "Moral hazard, adverse selection, and the optimal provision of social insurance." *Journal of Public Economics* 22, p. 49-71.

World Commission on Environment and Development [1987]. *Our Common Future*. New York: Oxford University Press.